The treatment of pumping joints has never been done on a big scale in Indiana, and all experiments are so recent that neither results nor costs can be judged accurately.

This work in the Seymour District differs in method, materials, and equipment from similar operations in other states, where bituminous material is used to fill the cavity under a pumping joint.

Our first operation in treating joints is the drilling of holes. This procedure necessitates the use of an air-compressor and rock-drill fitted with the proper-sized bits. The joints needing treatment are painted in advance of the crew doing the drilling so that there will be no attempt made to treat joints that are not pumping. The holes are usually drilled from 18" to 24" away from the joint in the direction that traffic is moving, and as a rule two holes are drilled on each side of the center-line. This system is altered to fit conditions arising from longitudinal joint pumping or other pumping caused by failure in pavement.

The mud-jack being used at present is a 1933 model Ingersoll-Rand which is a combination mud-jack and air-compressor. This piece of equipment originally cost $2,450 and has been in almost constant operation, usually as a compressor only. It operates by creating a vacuum which sucks the material into a chamber, and then this material is forced under the pavement by compressed air. Although this machine has been satisfactory and fair progress has been made with it, some improvements are needed to make it more satisfactory when using the rapid-setting slurry that we are now putting through the mud-jack. One of the difficulties arises from the necessity of periodically cleaning out two hand-operated valves, one of which opens and closes the intake into the chamber and the other, the outlet. These valves naturally become coated and have to be taken off and cleaned at least once a day, even when the machine is washed out with water after every batch.
We first used a mixer to mix the grout, but because this meant one more piece of equipment, we now mix this material by hand in half an oil drum. One man with a wooden paddle can easily mix enough material to keep the mud-jacking operation at its top rate of production. In keeping the road open to traffic, only one side of the pavement is treated at a time and this requires moving the machine frequently.

**Mixture Used**

The mixture that we are now using consists of 85 pounds of natural cement, 17 pounds of lumnite cement, and 57 pounds of water. This was determined by experimenting to arrive at a mix that would set in 25 to 30 minutes during the winter months when air and subgrade temperatures are low. The mix will have to be altered during warmer weather.

The above weights make up one batch, which is immediately pumped under the pavement. We have found that the average pumping joint will take one batch to each lane of the pavement. Some joints have taken as many as four batches on one side when no attempt was made to raise the slab but just to fill the cavity existing under the pavement.

Ordinarily it takes from 8 to 15 minutes to treat one half of a joint. Barricades are kept back of the operation until 30 minutes have lapsed before traffic may run over the freshly treated joint.

It is important that the hole next to the centerline be pumped first so that all mud and water is expelled to the edge of the slab. It is also important that no treating be attempted when there is a trace of ice or frozen mud under the pavement.

A complete crew includes five men, one of whom has no duties other than flagging traffic. Three men operate the mud-jack and mix material, while one man is kept busy moving the barricades up and moving the water tank and mud-jack ahead as each joint is completed.

On one typical section of concrete pavement, 0.50 miles in length and 22 feet in width, every expansion and contraction joint was pumping badly. There were 68 joints to treat in this section. This was done a few weeks ago, and at present only one joint of the 68 is showing any evidence of pumping. By spring this section of pavement, approximately five miles south of U. S. 50 on U. S. 31, should give us a very good indication of results to expect from this type of treatment.

At the present time we are paying $0.60 a bag for natural cement and $2.50 a bag for lumnite cement. On the above-mentioned section of road, the cost of material alone came to $2.56 per joint. The cost of labor is variable, depending on the length of moves between joints and
the amount of material used at each joint. At present the labor cost has been between $2.00 and $3.00 per joint, and of this amount 30 percent has to be charged to drilling.

Although this cost of $5.00 per joint may seem prohibitive, we believe that this money is well spent if the pavement can be saved for future resurfacing.